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2005 Summary of the Weir Herring Tagging Project, with an Update of the HSC/PRC/DFO Herring Tagging Program

Résumé pour 2005 du Projet d'étiquetage du hareng capturé dans des bordigues et mise à jour du Programme d'étiquetage du hareng HSC/CRPP/MPO

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ABSTRACT

In the last seven years two separate herring tagging projects have been conducted in maritime Canadian waters. The first project, conducted between 1998 and January 2002 by the Pelagics Research Council/Herring Science Council (PRC/HSC), in partnership with Fisheries and Oceans Canada, tagged herring on spawning grounds and on the major Nova Scotia overwintering grounds. A total of 92 647 herring were tagged. Although this project has concluded tags continue to be returned. The information on tags returned in 2004 is presented in this paper.

The current tagging project began in August 2002. Fundy Weir Fishermen Association, in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, Grand Manan Fishermen's Association, Connors Brothers Ltd. and Fisheries and Oceans Canada, initiated a program to tag weir herring in the Bay of Fundy. The purpose of this ongoing project is to investigate the within season movement and migration of weir herring in the Bay of Fundy with the long term goal of providing information on stock structure. Since the start of this project a total of 77 957 herring have been tagged and 2 742 tags have been recovered. The majority of recoveries have been from close to the site of application. However, there have also been some recoveries from fish caught on Scots Bay and German Bank, off Coastal Nova Scotia and the USA and from mixed aggregations off the Long Island Shore.

RÉSUMÉ

Au cours des sept dernières années, deux projets distincts de marquage du hareng ont été entrepris dans les eaux maritimes canadiennes. Le premier, réalisé entre 1998 et janvier 2002 par le Conseil des recherches sur les pêches pélagiques et le Herring Science Council (CRPP/HSC), en partenariat avec Pêches et Océans Canada, a permis de marquer des harengs dans leurs frayères et leurs principales aires d'hivernage dans les eaux de la Nouvelle-Écosse. Au total, 92 647 harengs ont été étiquetés. Quoique ce projet ait pris fin, des étiquettes continuent d'être retournées. Le présent document est un résumé des renseignements tirés de celles retournées en 2004.

Le projet de marquage actuel a commencé en août 2002. La Fundy Weir Fishermen Association, en partenariat avec le ministère de l'Agriculture, des Pêches et de l'Aquaculture du Nouveau-Brunswick, la Grand Manan Fishermen's Association, Connors Brothers Ltd. et Pêches et Océans Canada, a alors lancé un deuxième programme d'étiquetage du hareng dans la baie de Fundy. L'objectif de ce projet est d'établir les déplacements saisonniers et les migrations du hareng dans la baie de Fundy, le but à long terme étant de recueillir de l'information sur la structure des stocks. Depuis le début du projet, un total de 77 957 harengs ont été étiquetés et 2 742 étiquettes ont été retournées. La plupart de celles-ci ont été récupérées près du point où elles ont été posées, mais quelques-unes proviennent de la baie Scots et du banc German, situés au large de la Nouvelle-Écosse et des États-Unis, ainsi que dans de bancs mélangés présents au large des côtes de Long Island.

1. Introduction

Management of the herring fishing industry has been partly based on tagging studies conducted almost thirty years ago. Many significant changes in the fishery and the environment have occurred since these studies, and there was a need for the stock structure and movement patterns to be re-evaluated. To this end, two large scale tagging projects have been undertaken. The Pelagics Research Council/Herring Science Council, in collaboration with Fisheries and Oceans Canada, conducted a tagging project from August 1998 to January 2002 directed primarily at adult herring on spawning grounds. In the fall of 2002, the Fundy Weir Fishermen Association, in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, Connors Brothers Ltd., Grand Manan Fishermen's Association and Fisheries and Oceans Canada (DFO), initiated a second herring tagging study focusing on herring from the weir fishery. The purpose of these programs was to investigate stock structure, fish migration and movement patterns (Mouland *et al.*, 2003). This document is a summary of tag returns that have come in from the Fundy Weir Fishermen Association and PRC/HSC programs.

2. PRC/HSC Tagging Project (1998-2002): Update 2005

2.1 Results

A total of 92 647 herring were tagged throughout the Maritimes in various locations (see Mouland *et al.*, 2003). There have been 912 recoveries from this tagging thus far. The calculated return rate is just below 1%. Figures 1 and 2 show the location of areas discussed in the results.

Nineteen tags were returned in 2004 (Table 1). Thirteen of these tags came from herring that were recaptured in 1999 and 2000, and not returned until August, 2004. The remaining 6 tags were from fish caught in the 2004/2005 fishing season. Seven tags were returned with no location information (Table 1).

Five tags that were applied to New Brunswick weir herring in 1999 and 2000 were returned with information indicating that they were caught in either the New Brunswick or Nova Scotia weir fishery. One weir fish tagged at the Wolves was recovered along the Long Island Shore after 43 days. Another weir fish tagged in the West Isles area in September, 2000 was returned four years later from USA waters off the coast of Maine. There was one recovery from a herring tagged on the German Bank spawning grounds in 1998 that was recaptured from the New Brunswick winter purse seine fishery around the Wolves in 2005. It spent 2 322 days at liberty. There were four returns with complete information from fish tagged off Chebucto Head. One fish, tagged off Chebucto Head in January 1999 was caught a year and a half later off the Long Island Shore. Three tags from fish tagged off Chebucto Head in January 2002 were returned from the Scots Bay spawning grounds in August 2004.

3. Weir Tagging Project: Update 2005

3.1 Introduction and Background

The weir fishery is a passive fishery that is not subject to any catch limits but is restricted by resource and site availability as well as market (Canada, 2003). Recent changes in fishing activity, including the resurgence of a fishery on George's Bank, the decline in the number of active weirs in the Bay of Fundy and the increase in the number of aquaculture sites, prompted scientists and industry to re-evaluate issues relating to the Bay of Fundy herring stocks (Mouland *et al.*, 2003).

Patterns of movement and migration of herring within the Bay of Fundy are not well documented and hypotheses are based largely on anecdotal information from fishers (Mouland *et al.*, 2003). Intensive tagging is being conducted to allow for an examination of the fine scale intra-seasonal movement of fish within the Bay of Fundy. This information can be used to investigate migration routes, intra-seasonal distribution frequency, and the degree to which the same schools of herring contribute to catch in different areas of the Bay. According to the historical catch data from 1999-2002 herring move into weirs around Bliss, Deer and Campobello Islands in May and then spread toward Grand Manan in June. Finally, they enter the weirs off the Wolves in July (Mouland *et al.*, 2003). These catch data are, however, dependent largely on market. Tagging provides an opportunity to if this is a distinct group of fish, or distinct aggregations, as well as providing information on larger scale movements.

Improving information on stock structure for U.S. and Canadian transboundary science and management purposes is an objective of this project. Currently, juvenile herring caught in New Brunswick weirs are considered to originate from U.S. waters (NAFO areas 5Y and 5Z) and are therefore not considered part of the 4WX (Canadian) herring Total Allowable Catch (TAC) (Power *et al.*, 2004). It has been suggested, that a proportion of these fish may also originate from the Bay of Fundy/Southwest Nova Scotia stocks. Tag returns from fisheries in U.S. and Canadian waters are being used to test this hypothesis.

Analyses of mortality due to tagging and tag retention are also objectives of this program. In 2004, some double tagging was conducted to determine how well the tags are retained by the fish. Estimation of tag shedding rates from double tagging experiments is an integral part of tagging projects (Adam, 2001). Failure to allow for tag shedding can result in biases in estimates in such parameters as migration and movement rates (Adam 2001, Fabrizo *et al.* 1999, Xiao, 1996). Tag induced mortality and tag loss reduces the size of the marked population (Renones and Goni, 2000) and hence the tag return rate.

3.2 Material and Methods

The methods of both tagging programs have been previously documented in Paul (1999), Waters *et al.* (2000), Mouland *et al.* (2002) and Waters and Clark (2004).

In 2002, a protocol was implemented when two size classes of fish were present in the weir. Each size class was tagged with a different series of tag numbers, and recorded. Using previous length frequency sample from the weir fishery, 23 cm. was used as a cut off between a large herring ($\geq$ 23 cm.) and a small herring ($<$ 23 cm.). This protocol was continued in 2003 and 2004.

In 2004 a double tagging experiment commenced. Five hundred fish were double tagged throughout the season. Generally, double tagging events took place at the first tagging event of each week. Fifty fish had two tags applied in each designated tagging session. The tags were inserted into the musculature between two fin ray spins at the base of the dorsal fin, approximately 2 cm apart. Herring that received double tags were not selected on the basis of size.

3.3 Results and Discussion

Since this project began, 77 957 herring have been tagged (Table 2). Thus far, 2 742 tags have been returned. Tagging in the first year of the project began near the end of the fishing season. Between the end of August and November 2002, twenty-one tagging events saw the placement of 13 760 tags (Mouland *et al.*, 2003). Ninety-three of these tags were returned by the early winter of that year. The late start and the relatively small number of returns precluded the examination of the in-season movements of herring in 2002.

The fishery in 2003 got off to a slow start and the overall landings for the season were the lowest in twenty years (Power *et al.*, 2004). However, 54 tagging events resulted in the placement of 32 570 tags on herring in the Bay of Fundy (Table 2).

In 2004 the landings were greater than in the previous two years; double the 2003 landings and slightly above the average for the previous ten years (Power *et al.* 2005). Forty-three tagging events resulted in the placement of 31 627 tags on herring in the Bay of Fundy (Table 2).

3.3.1 Tag Applications

Tagging locations have been broken down into seven tagging areas to aid in the interpretation of the data (Figure 2). In 2002, tagging effort was concentrated at the Wolves, West Isles and the Bliss Island areas (Figure 3). In 2003 the majority of the tagging effort was concentrated on weirs around Grand Manan and the West Isles, followed closely by the Bliss Island area (Figure 4). In 2004, tagging effort was concentrated at the Wolves and Bliss Island areas, followed by Campobello and the West Isles areas (Table 2 and Figure 5). The concentration of tagging effort reflects which weirs were landing fish and accordingly which were available to the project.

In 2004, very little tagging took place in May and June (Table 2 and Figure 5). In the month of July the number of tagging trips increased, comparable to the previous year. Tagging peaked in August and September. One trip in October completed the season.

The majority of fish tagged were juveniles (Figure 6) however, during several tagging events, it was obvious that there were two size groups of fish present in the weir (Figure 7). Herring landed in the weir fishery were primarily juveniles (ages 1 to 3) with some adults (Power *et al.*, 2004; Mouland *et al.*, 2003).

3.3.2 Days at Large

It is evident from the number of tag returns that tagged herring are surviving the initial tagging experience. It is also apparent that tagged herring can survive on a long term basis. The fish that was at large for the longest period of time in the weir tagging program, thus far, was recaptured after 681 days.

3.3.3 Tag Return Rates

A total 2 742 of tags have been returned since 2002. To date, 144 tags have been returned from herring tagged in the 2002 season, 1 289 tags have been returned from fish tagged in the 2003 season and 1 309 have been returned from tagging completed in 2004. Returns for fish at large for greater than 4 days are shown by area tagged and recovered for all weir tagging events, (Table 3 and Figure 8).

The recapture of 2 742 tags established an overall return rate of 3.5%, calculated for all tags returned since the beginning of the weir tagging program. This rate drops to 3.2 % if only tags from fish at large for greater than 4 days are used. This is comparable to the return rate documented in other herring tagging experiments in the same area (McKenzie and Tibbo, 1958; McKenzie and Skud, 1958, Stobo *et al.*, 1975).

3.3.4 In Season Migration - 2004

The objective of identifying migration and movement patterns of herring within a single fishing season is gradually being met. The late start in the first season made it impossible to look at this factor for the first year of the project. Descriptive results from the second and third years of the project are shown here.

In 2003 there were sufficient tag returns from tags applied in two areas (Bliss Islands and Grand Manan) to allow for the examination of intra-seasonal movements within the Bay of Fundy. For these areas, only tag returns from fish caught more than four days after tagging were examined. The majority of returns for both areas showed that the majority of tagged fish stay in the local tagging area. However, tagged herring from Grand Manan were also found on the other side of the Bay of Fundy, German Bank, and in U.S. waters. Returns from tagged herring from the Bliss Islands indicated that most of these fish stayed in the Quoddy Isles area throughout the fishing season, but there were also returns from other areas such as the eastern side of the Bay of Fundy, Gulf of Maine, Scots Bay, and U.S.A. waters. This is consistent with the hypothesis that this is a complex of fish originating from more than one spawning component (Stobo *et al.*, 1975).

In 2004, there were sufficient tag returns from tags applied in three areas to allow for the examination of intra-seasonal movements within the Bay of Fundy (Table 3). These areas were the Bliss Islands, Coastal Mainland New Brunswick and the Wolves Islands. Tag returns from fish caught more than four days after tagging were examined to see if there was any pattern. Consistent with 2003 results, in 2004 the majority of tag returns were from the local tagging area.

A total of 7 456 tags were applied during 13 tagging trips to the Bliss Island area in 2004. Results are shown in Table 4. The majority of the tags returned were from the local Quoddy Isles tagging area (93%). The other returns came from Scots Bay (10), German Bank (1), from mixing aggregations in Saint Mary's Bay (1), Sandy Cove (3), Long Island Shore (2), and both Moore's (1) and Northwest Ledges (4). There were also two recoveries from the USA. This is consistent with the results from tagging in 2003.

A total of 8 212 tags were applied during 9 tagging trips to the Wolves area in 2004. The majority of the tags returned were from the local tagging area (96%). Other recovery locations include Northwest Ledge (3), Sandy Cove (1), Scots Bay (4) and the USA (1) (Table 4).

A total of 2 363 tags were applied during 3 tagging trips to the Coastal Mainland New Brunswick area in 2004. The majority of the tags returned were from the local tagging area (97%). There was one tag return each from Scots Bay, Northwest Ledge, and Lurcher (Table 4).

Tag recoveries are concentrated in the areas where fishing effort was placed. To this end, there have been a larger number (418) of tags recovered from the NB winter purse seine fishery (Table 5). This is consistent with the hypothesis that many juvenile herring overwinter in the Bay of Fundy (Stobo *et al.*, 1975). The tags returned from the winter purse seine fishery have come from fish tagged in all weir tagging locations except Saint Mary's Bay. Over 40% of the recoveries have come from herring tagged from weirs around the Wolves.

On November 04, 2002, 1 021 tags were applied to herring from the NB winter purse seine fishery in the Grand Manan area. There have been seven recoveries from this tagging trip. Four recoveries were from the winter purse seine fishery the following January: 3 in the vicinity of Grand Manan and 1 near the Wolves. There were 2 tags returned from Moore's Ledge in August, 2003 and 1 from German Bank in April 2003.

3.3.5 Long Term Movement and Migration

Twenty five tags applied in 2002 have been returned during the 2003 and 2004 fishing seasons (Table 6). Over half (56%) of these tags were returned from the local Quoddy Isles tagging area. The others were from German Bank (2), Moore's Ledge (5), Nova Scotia (1) and The Prong (3).

Twenty three tags applied in 2003 have been returned from the 2004 season. Sixty percent of these tags were recovered in the local tagging area. The remainder were recovered from Moore's Ledge (1), Northwest Ledge (2), Southwest Ledge (2), Pollock Grounds (2), and Long Island Shore (2) (Table 7).

There have been nine returns from herring that were at large for more than a year. These tags were applied at the Bliss Islands, Deer Island, Grand Manan and the West Isles. All of the returns have been from the local tagging area except one that was recaptured at Northwest Ledge (Table 8).

3.3.5.1 Migration

Herring that have been recovered on the spawning grounds of Scots Bay (28) have been from fish tagged at Bliss Islands (15), Campobello (3), Coastal Mainland NB (1), Grand Manan (1), Moore's Ledge (2), West Isles (2) and the Wolves (4). Twenty two tags from tagging events where both large and small fish were tagged separately have been returned from Scots Bay (Table 9). Of these 22 tags, 17 were applied to large fish (>23cm) indicating that they were likely to be adults. Maturity samples taken at the time of tagging indicated the presence of adult fish in a range of maturity stages (Figure 9).

Herring that have been recovered from German Bank (6) have been from fish tagged at Bliss Islands (2), Coastal Mainland NB (1) and Grand Manan (3). Of the 6 tags returned two were caught outside the usual spawning season on German Bank and only one return was from a large (>23cm) fish (Table 10).

Herring that have been recovered from the USA (23) have come from fish tagged at Bliss Islands (11), Campobello (1), Coastal Mainland NB (1), Deer Island (1), Grand Manan (3), West Isles (4) and the Wolves (2). These recoveries have come from all along coastal USA and as far away as Hudson Canyon, close to New Jersey (Table 11). It has been hypothesized that some adult herring from the Bay of Fundy overwinter and spawn in the USA waters (Stobo, 1982).

3.3.6 Double Tagging

Five hundred herring were double tagged during the 2004 fishing season. Fifty-two tags were recovered in 36 fish. Twenty were single tags and 16 were double tags. Based on these statistics, approximately 55% of recovered fish lost one of their tags.

3.4 Conclusion

The third season of the herring weir tagging project was successfully completed. Most tag recoveries have been from the local tagging area. These areas include the summer and fall weir fishery and the winter purse seine fishery around Grand Manan and the Wolves. In addition, there have been recoveries from the eastern side of the Bay of Fundy, German Bank, the spawning grounds of Scots Bay and from USA waters as far south as Hudson Canyon.

3.5 Recommendations

It is recommended that:

- The tagging program continues for another year to meet the goal of > 100 000 fish tagged and to insure a sufficient number of tag returns.
- Double tagging continues to get a better estimate of tag loss.
- There should be close cooperation with herring processors to ensure that we get complete tag return information.
- There be continued advertising of the program.
- There be continued cooperation and data exchange with Maine Department of Marine Resources Herring Tagging Program.

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Tables

Table 1: PRC/HSC Tag Returns from March 1, 2003 to March 1, 2004. Large fish are ≥ 23 cm and small fish are < 23 cm.

Date Tagged	Tagging Location	Days at Large	Return Date	Return Location	Size
16-Aug-99	Bliss Islands	11	27-Aug-99	NS or NB Weir	
26-Jan-99	Chebucto Head	540	19-Jul-00	Long Island Shore	
09-Jan-02		959	25-Aug-04	Scots Bay	
09-Jan-02		964	30-Aug-04	Scots Bay	Large Fish
10-Jan-02		944	11-Aug-04	Scots Bay	Large Fish
26-Jan-99		160	05-Jul-99	Unknown	Large Fish
09-Jan-00		162	19-Jun-00	Unknown	Large Fish
09-Jan-00		174	01-Jul-00	Unknown	
09-Jan-02		978	13-Sep-04	Unknown	
29-Nov-99	Chedabucto Bay	208	24-Jun-00	Unknown	
03-Sep-98	German Bank	2322	11-Jan-05	NB Winter Fishery (Wolves)	
21-Aug-99	Scots Bay	315	01-Jul-00	Unknown	Large Fish
18-Aug-99	West Isles	12	30-Aug-99	NS or NB Weir	
22-Sep-00		13	05-Oct-00	NS or NB Weir	Small Fish
22-Sep-00		1365	18-Jun-04	Outside Matinicus Rock	
20-Sep-00		8	28-Sep-00	Unknown	Small Fish
08-Sep-99	Wolves	43	21-Oct-99	Long Island Shore	
24-Aug-99		6	30-Aug-99	NS or NB Weir	Small Fish
21-Sep-00		27	18-Oct-00	NS or NB Weir	Small Fish

Table 2: Number of Herring Tagged by Month, Location and Year

		May-Jun	July	Aug.	Sept.	Oct.	Nov.	Totals
	Location							
2002	Bliss Islands	0	0	640	2201	1275	0	4116
	Grand Manan	0	0	0	229	0	1021	1250
	West Islands	0	0	0	3493	2266	0	5759
	Deer Island	0	0	0	1129	0	0	1129
	Wolves	0	0	0	1006	500	0	1506
	Nova Scotia	0	0	0	0	0	0	0
	Campobello	0	0	0	0	0	0	0
	Coastal Mainland, NB	0	0	0	0	0	0	0
	Totals	**0**	**0**	**640**	**8058**	**4041**	**1021**	**13760**
2003	Bliss Islands	393	800	2912	1248	250		5603
	Grand Manan	773	3050	1797	2435			8055
	West Islands		896	4133	1370	1885		8284
	Deer Island			900	2124	675		3699
	Wolves		400		1351	2400		4151
	Nova Scotia				241			241
	Campobello				296			296
	Coastal Mainland, NB		1000	800	441			2241
	Totals	**1166**	**6146**	**10542**	**9506**	**5210**		**32570**
2004	Bliss Islands	0	2000	3903	1553	0	0	7456
	Grand Manan	0	310	1596	0	0	0	1906
	West Islands	0	2440	583	964	891	0	4878
	Deer Island	0	0	0	0	0	0	0
	Wolves	0	950	1746	5516	0	0	8212
	Nova Scotia	989	0	0	0	0	0	989
	Campobello	0	0	1928	2399	0	0	4327
	Coastal Mainland, NB	0	0	1463	900	0	0	2363
	Other	1496	0	0	0	0	0	1496
	Totals	**2485**	**5700**	**11219**	**11332**	**891**	**0**	**31627**
	Grand Totals	**3651**	**11846**	**22401**	**28896**	**10142**	**1021**	**77957**

Table 3: Tag releases and returns by area for 2002, 2003, and 2004. Only returns greater than four days at large are included.

		NB Weirs							Tags Applied -		Fall Purse Seine	Spring Purse Seine		
		Bliss	Camp	CMI NB	Deer	GM	West Isles	Wolves	SMB	Sandy Cove	Grand Manan	NE Bank	Moores Ledge	Totals
	Total No. Tagged →	17175	4623	4604	4828	10190	18921	13869	989	241	1021	451	1045	77957
	Return Area ↓													
NB Weirs	Bliss Islands	98	4	19	1	4	15	24						165
	Campobello	28	16	5	2	1	10	7						69
	Coastal Mainland NB	25		2	3	3	18	5						56
	Deer Island	33	6	7	11	1	26	13						97
	Grand Manan	49	7	12	11	62	37	22			3			203
	Grand Manan / Wolves	15	1	10			4	18						48
	NB Weir	127	19	12	12	17	55	42					2	286
	West Isles	26		2	1	2	9	4						44
	Wolves	94	11	31	25	15	90	189			1		2	458
NS	Saint Mary's Bay	1							1					2
	Sandy Cove	9				2	4	1						16
Other														
	Bay of Fundy	6	1			2	1	1						11
	German Bank	2		1		1					1			5
	Grand Manan Banks	2		1	1		1	5						10
	NS/Eastern BOF	2		1			6						1	10
	Northwest Ledge	6		1		2	2	3						14
	Scots Bay	12	2	1		1	2	4					2	24
	Long Island Shore	2			1	1	1	2						7
	Moores Ledge	1			1		3		2		2			9
	The Prong	1			3	2	2							8
	Pollock Grounds					1	1							2
	Southwest Ledge					1	1							2
	NB Winter Seine	75	3	45	24	14	87	168		1			1	418
USA														
	USA	11	1	1	1	3	3	2						22
	Unknown	189	27	12	19	47	105	84			3		3	489
	Totals	814	98	163	116	182	483	594	3	1	10	0	11	2475

Table 4: Tag Recoveries of Tags Applied and Recovered in 2004; >4 Days at Large.

Area Tagged	Return Area	Number of Returns
Bliss Islands	Bay of Fundy	4
No. of tags applied:	Bliss Islands	82
7 456	Campobello	17
	Deer Island	18
No. of tags returned	German Bank	1
> 4 days at large	Grand Manan	23
503	Grand Manan / Wolves	15
	Long Island Shore	2
Tag Return Rate	Moore's Ledge	1
6.7%	NB Weir	93
	NB Winter Fishery	54
	Northwest Ledge	4
	Nova Scotia	1
	Saint Mary's Bay	1
	Sandy Cove NS	3
	Scots Bay	10
	USA	2
	West Isles	23
	Wolves	59
	Unknown	90
Wolves	Bay of Fundy	1
No. of tags applied	Bliss Islands	24
8 212	Campobello	7
	Deer Island	6
No. of tags returned	Grand Manan	15
> 4 days at large	Grand Manan / Wolves	18
292	NB Weir	34
	NB Winter Fishery	50
Tag Return Rate	Northwest Ledge	3
3.6%	Sandy Cove NS	1
	Scots Bay	4
	USA	1
	West Isles	3
	Wolves	91
	Unknown	34
Coastal Mainland NB	Bliss Islands	17
No. of tags applied	Campobello	5
2 363	Deer Island	6
	German Bank	1
No. of tags returned	Grand Manan	7
> 4 days at large	Grand Manan / Wolves	10
120	Lurcher	1
	NB Weir	6
Tag Return Rate	NB Winter Fishery	34
5.1%	Northwest Ledge	1
	Scots Bay	1
	West Isles	1
	Wolves	23
	Unknown	7

Table 5: Summary of Recoveries From NB Winter Purse Seine Fishery by Tagging Location.

Area Tagged	Number of Returns
Bliss Islands	75
Campobello	3
Coastal Mainland, NB	45
Deer Island	24
Grand Manan	14
Moore's Ledge	1
Sandy Cove, Nova Scotia	1
West Isles	87
Wolves	168
Total	418

Table 6: Recoveries of Tags Applied in 2002 from the 2003 and 2004 Fishing Seasons.

Area Tagged	Date Tagged	Return Area	Return Date
Bliss Islands	04-Oct-02	Bliss Islands	18-Aug-03
	25-Sep-02	German Bank	03-Jul-03
	25-Sep-02	NB Weir	02-Sep-03
	04-Oct-02	NB Weir	19-Aug-03
	25-Sep-02	NB Weir	31-Jul-03
	25-Sep-02	The Prong	17-Jul-03
Deer Island	18-Sep-02	Campobello	04-Jun-03
Grand Manan	04-Nov-02	German Bank	28-Apr-03
	04-Nov-02	Moore's Ledge	15-Jul-03
	04-Nov-02	Moore's Ledge	21-Jul-03
West Isles	24-Sep-02	Bliss Islands	29-Jul-03
	10-Oct-02	Grand Manan	01-Oct-03
	24-Sep-02	Grand Manan	10-Sep-03
	26-Sep-02	Moore's Ledge	16-Jul-03
	18-Sep-02	Moore's Ledge	15-May-03
	24-Sep-02	Moore's Ledge	24-Jun-03
	10-Oct-02	NB Weir	20-Aug-03
	26-Sep-02	Sandy Cove, Nova Scotia	05-Aug-03
	10-Oct-02	The Prong	01-Jul-03
	10-Oct-02	The Prong	11-Jul-03
	10-Oct-02	Wolves	13-Jun-03
	10-Oct-02	Wolves	24-Oct-03
	04-Oct-02	Wolves	15-Oct-03
Wolves	08-Oct-02	Grand Manan	09-Jun-03
	08-Oct-02	NB Weir	11-Aug-03

Table 7: Recoveries of Tags Applied in 2003 from the 2004 Fishing Season.

Date Tagged	Area Tagged	Return Date	Return Area
11-Aug-03	Bliss Islands	15-Aug-04	Bliss Islands
24-Sep-03	Coastal Mainland NB	17-Sep-04	NB Weir
22-Sep-03	Deer Island	07-Jun-04	Bliss Islands
07-Oct-03		27-Sep-04	Campobello
22-Sep-03		21-Oct-04	Grand Manan
07-Oct-03		29-Jul-04	Moore's Ledge
07-Aug-03		17-Aug-04	NB Weir
07-Oct-03		12-Aug-04	NB Weir
22-Sep-03		19-Oct-04	NB Winter Fishery
16-Jun-03	Grand Manan	22-Oct-04	Bliss Islands
16-Jun-03		28-Sep-04	Northwest Ledge
16-Jun-03		27-May-04	Pollock Grounds
30-Sep-03		15-Jun-04	Southwest Ledge
23-Sep-03	West Isles	25-May-04	Bliss Islands
07-Oct-03		28-May-04	Bliss Islands
29-Jul-03		27-Jul-04	Grand Manan
07-Oct-03		04-Oct-04	Northwest Ledge
07-Oct-03		27-May-04	Pollock Grounds
07-Oct-03		21-Jun-04	Southwest Ledge
23-Sep-03		07-Dec-04	Wolves
02-Oct-03	Wolves	28-Jul-04	Long Island Shore
02-Oct-03		24-Jun-04	Long Island Shore
02-Oct-03		17-Aug-04	NB Weir

Table 8: Tag Returns > 365 Days at Large.

Date Tagged	Area Tagged	Return Date	Return Area	Days at Large
11-Aug-03	Bliss Islands	15-Aug-04	Bliss Islands	370
07-Aug-03	Deer Island	17-Aug-04	NB Weir	376
22-Sep-03		21-Oct-04	Grand Manan	395
22-Sep-03		19-Oct-04	NB Winter Fishery	393
16-Jun-03	Grand Manan	22-Oct-04	Bliss Islands	494
16-Jun-03		28-Sep-04	Northwest Ledge	470
04-Oct-02	West Isles	15-Oct-03	Wolves	376
10-Oct-02		24-Oct-03	Wolves	379
23-Sep-03		07-Dec-04	Wolves	441

Table 9: Tag Recoveries from the Scots Bay Area Grouped by Tagging Location. Large fish are ≥ 23 cm and small fish are < 23 cm.

Date Tagged	Area Tagged	Return Date	Days at Large	Size Tagged
06/08/2004	Bliss Islands	17/08/2004	11	Unknown
02/09/2003		03/09/2003	1	Large
21/08/2002		27/08/2002	6	Unknown
09/08/2004		18/08/2004	9	Large
09/08/2004		18/08/2004	9	Large
14/08/2003		02/09/2003	19	Large
08/08/2004		31/08/2004	23	Large
08/08/2004		27/08/2004	19	Large
08/08/2004		27/08/2004	19	Large
09/08/2004		27/08/2004	18	Large
03/08/2004		31/08/2004	28	Unknown
19/08/2004		09/09/2004	21	Small
09/08/2004		23/08/2004	14	Large
19/08/2004		23/08/2004	4	Small
23/08/2004		27/08/2004	4	Large
30/08/2004	Campobello	01/09/2004	2	Large
30/08/2004		08/09/2004	9	Large
30/08/2004		08/09/2004	9	Large
18/08/2004	Coastal Mainland NB	24/08/2004	6	Small
27/07/2004	Grand Manan	25/08/2004	59	Large
23/06/2004	Moore's Ledge	17/08/2004	55	Large
23/06/2004		03/08/2004	41	Large
29/07/2004	West Isles	18/08/2004	50	Small
29/07/2004		10/08/2004	12	Small
20/07/2004	Wolves	19/08/2004	30	Unknown
20/07/2004		19/08/2004	30	Unknown
10/08/2004		19/08/2004	9	Unknown
20/07/2004		19/08/2004	30	Large

Table 10: Tag Recoveries from the German Bank Area Grouped by Tagging Location. Large fish are ≥ 23 cm and small fish are < 23 cm.

Date Tagged	Area Tagged	Return Date	Days at Large	Size Tagged
25/09/2002	Bliss Islands	03/07/2003	281	Small
28/09/2004		06/10/2004	8	Small
27/09/2004	Coastal Mainland NB	06/10/2004	9	Small
04/11/2002	Grand Manan	28/04/2003	175	Large
18/09/2003		21/09/2003	3	Mix (98%Small)
16/06/2003		23/09/2003	99	Large

Table 11: Tag Recoveries from the USA Grouped by Tagging Location and Recovery Location. Large fish are > 23 cm and small fish are < 23 cm.

Date Tagged	Area Tagged	Return Date	Return Location	Days at Large	Size
21/08/2002	Bliss Islands	24/11/2002	Ipswich Bay, US	95	Unknown
14/08/2003		22/09/2003	Rockland - Matinicus Rock	39	Large
14/08/2003		26/08/2003	Schoodic Ridge	12	Large
14/08/2003		26/08/2003	Schoodic Ridge	12	Large
11/08/2003		26/08/2003	Schoodic Ridge	15	Large
17/06/2003		12/11/2003	Scantum Basin, Cape Anne, Mass.	148	Small
14/08/2003		26/08/2003	Schoodic Ridge	12	Large
03/08/2004		07/12/2004	Cape Cod	126	Small
08/09/2003		07/10/2003	Long Point, Cutler, Maine	29	Large
30/07/2004		16/11/2004	Gloucester USA	109	Unknown
13/09/2004	Campobello	04/12/2004	Nauset, Cape Cod, Mass.	82	Large
17/07/2003	Coast. Main. NB	17/09/2003	Schoodic Ridge	62	Small
07/10/2003	Deer Island	14/10/2003	USA	7	Small
21/07/2003	Grand Manan	17/09/2003	Mt. Desert Rock	58	Small
21/07/2003		17/09/2003	Mt. Desert Rock	58	Small
21/09/2003		19/02/2004	Hudson Canyon	153	Large
20/08/2003	West Isles	26/08/2003	Schoodic Ridge	6	Large
20/08/2003		26/08/2003	Schoodic Ridge	6	Large
29/07/2004		14/02/2005	Hudson Canyon	200	Unknown
20/08/2003		26/08/2003	Schoodic Ridge	6	Large
02/10/2003	Wolves	30/10/2003	East of New Harbour	27	Small
14/09/2004		05/03/2005	Hudson Canyon	172	Large
20/07/2004		11/10/2004	Seguin	83	Large

FIGURES

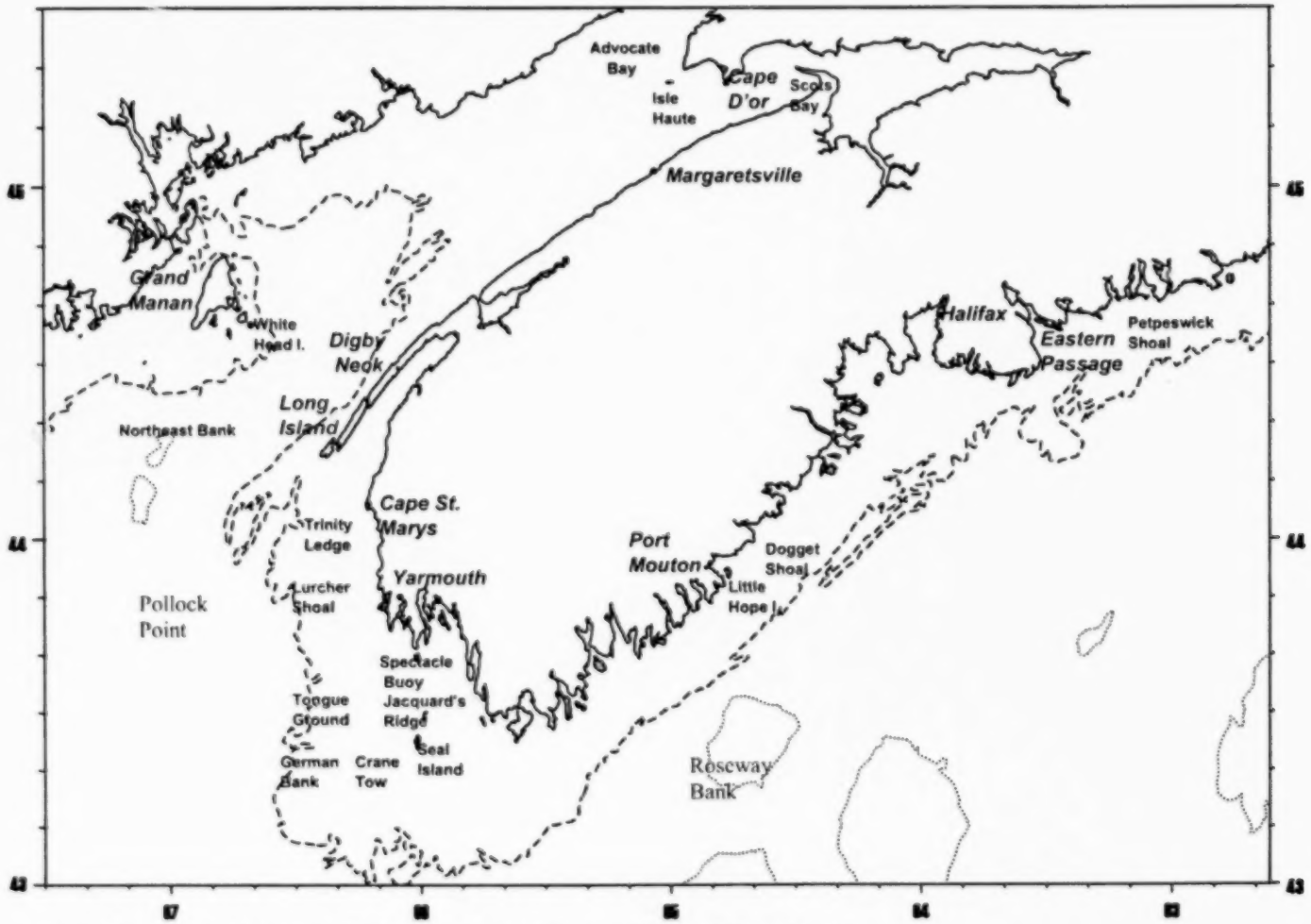

Figure 1: Fishing locations for herring in southwest and coastal Nova Scotia.

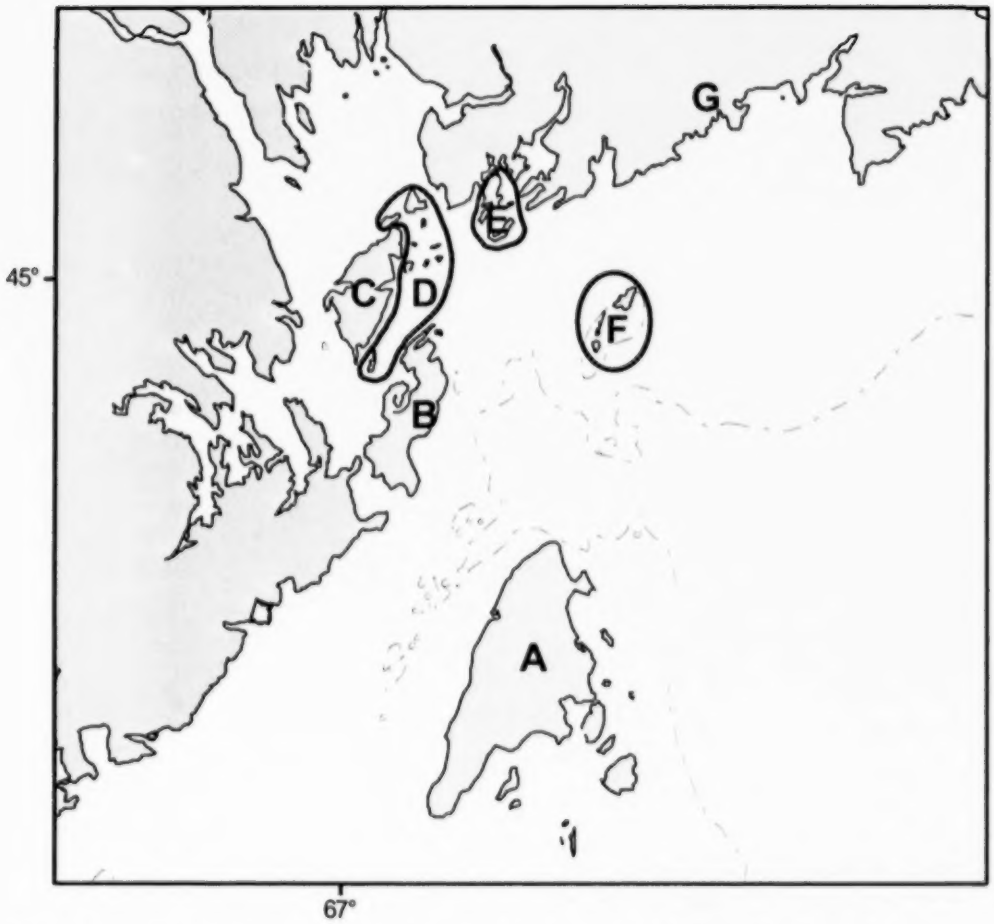

Figure 2: Map showing the areas discussed in the text. A is Grand Manan, B is Campobello Island, C is Deer Island, D is the West Isles, E is Bliss Island area, F is the Wolves Islands and G is the Coastal Mainland area.

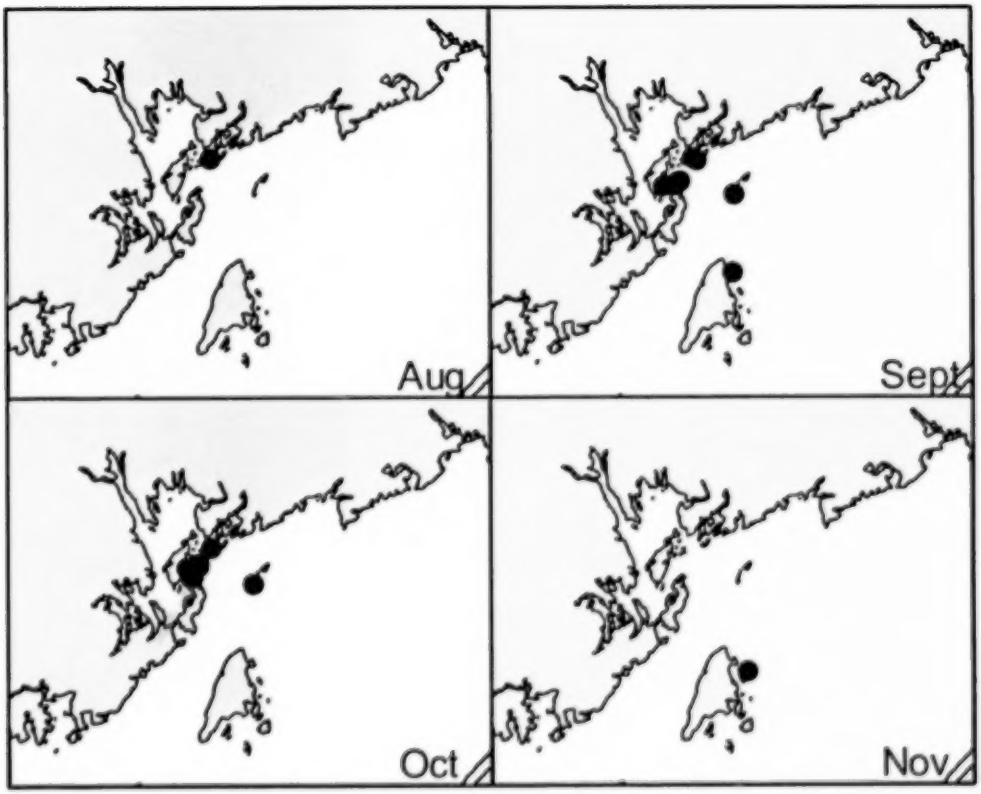

Figure 3: Tag application sites by month for 2002.

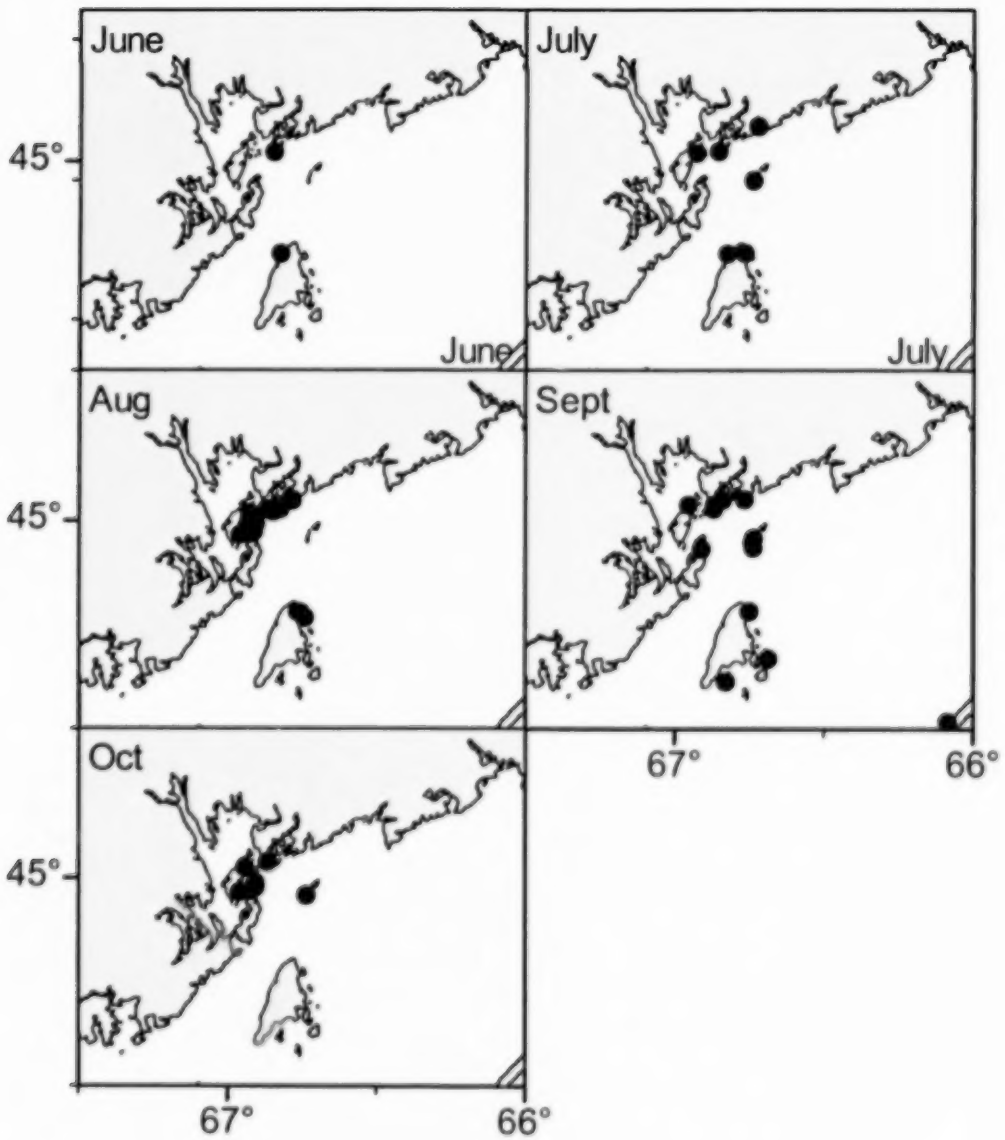

Figure 4: Tag applications sites by month for 2003.

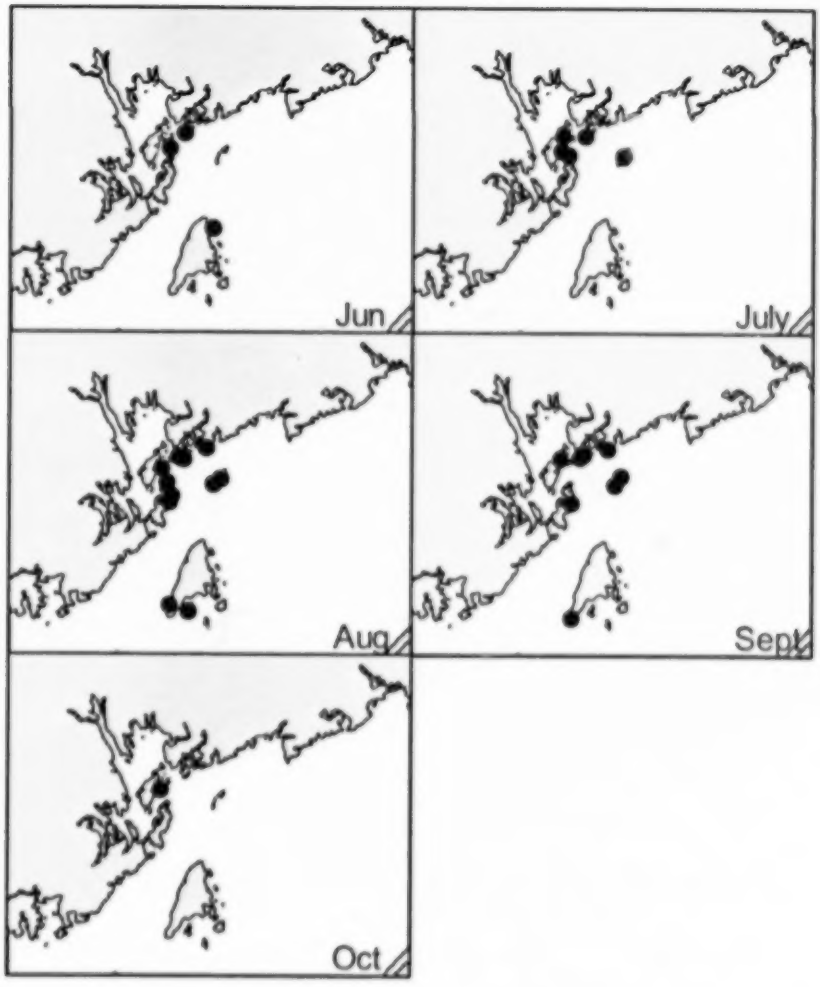

Figure 5: Tag application sites by month for 2004.

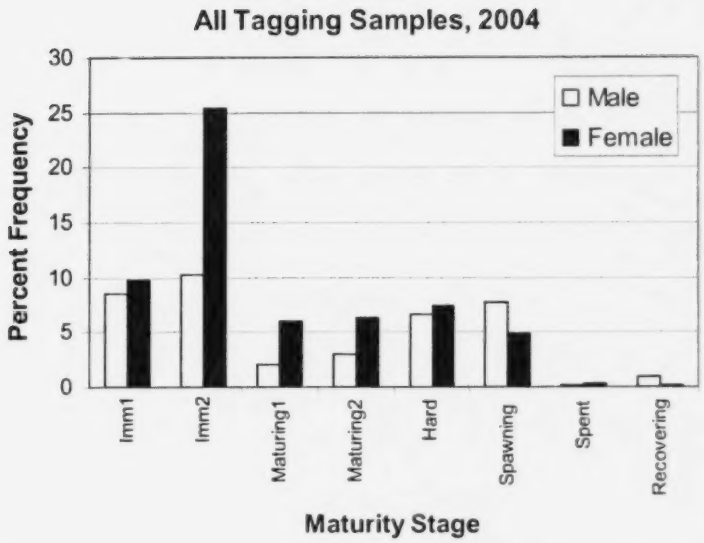

Figure 6: Percent frequency of maturity stages by sex for 30 tagging samples collected from the Quoddy Isles region from June to October, 2004.

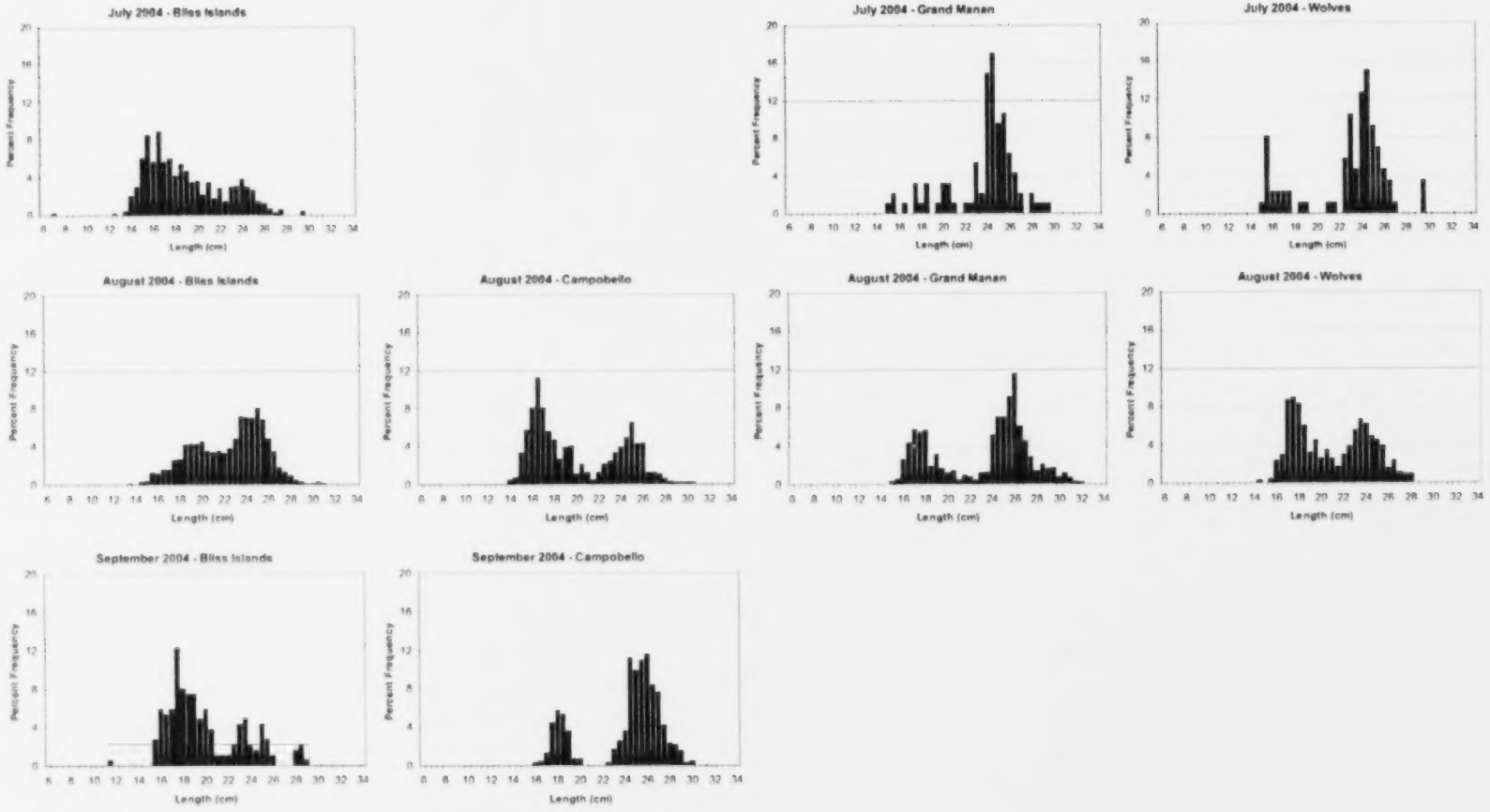
July 2004 - Bliss Islands
July 2004 - Grand Manan
July 2004 - Wolves
August 2004 - Bliss Islands
August 2004 - Campobello
August 2004 - Grand Manan
August 2004 - Wolves
September 2004 - Bliss Islands
September 2004 - Campobello
Percent Frequency
Length (cm)

Figure 7: Examples of instances when two size groups of herring were present in the weirs where tagging was being conducted.

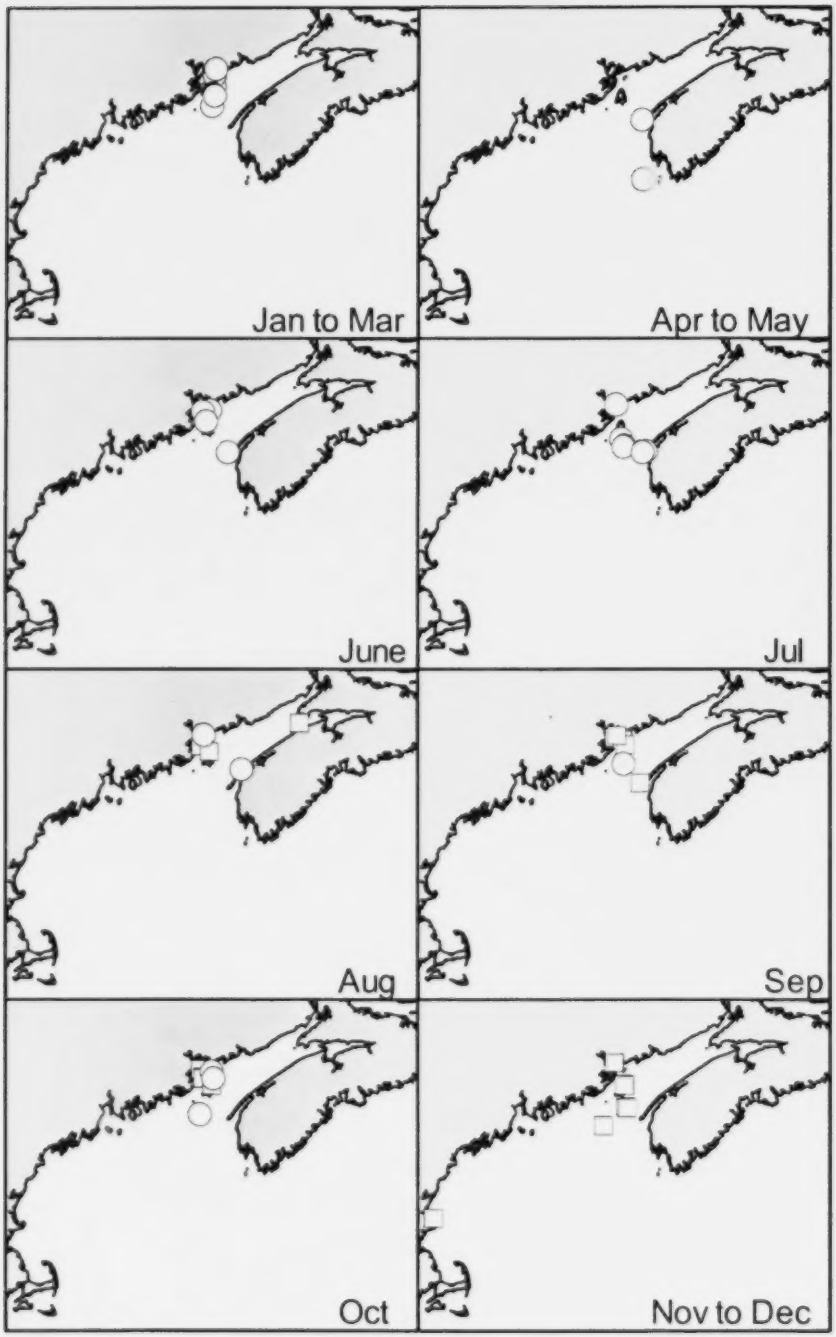

Figure 8a: Tag returns from herring tagged during the 2002 fishing season. Open squares indicate returns in 2002 and open circles indicate returns in 2003.

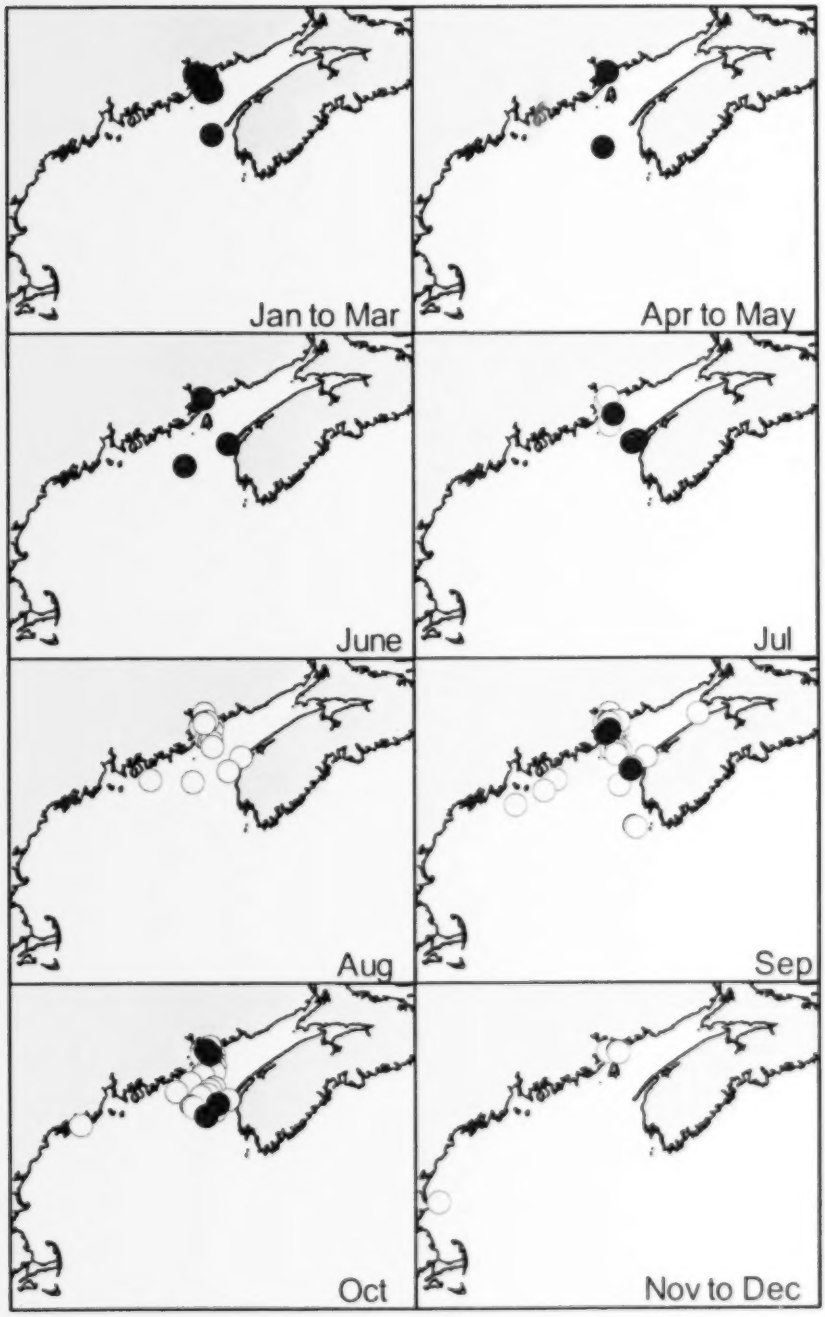

Figure 8b: Tag returns from herring tagged during the 2003 fishing season. Open circles indicate returns in 2003. Closed circles indicate returns in 2004.

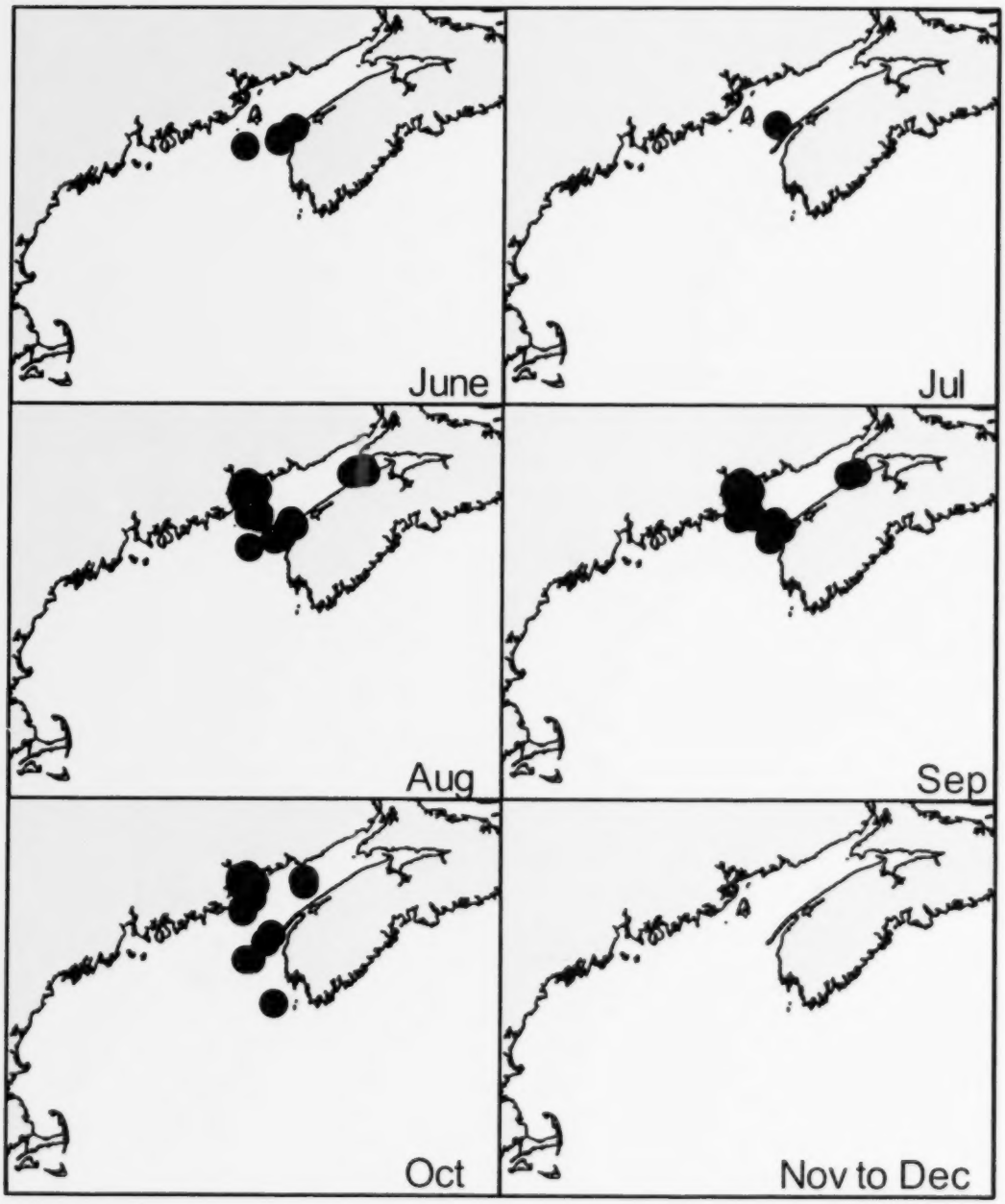

Figure 8c: Tag returns from herring tagged during the 2004 fishing season. Closed circles indicate returns in 2004.

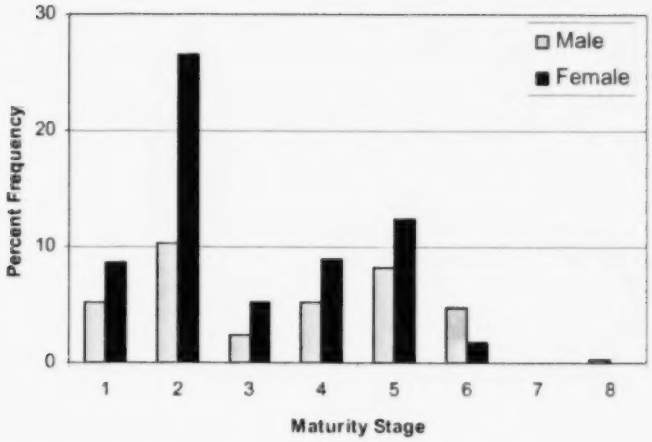

Figure 9: Collective maturity samples taken at the times of tagging for New Brunswick weir herring that were later caught on the spawning grounds of Scots Bay.